



2012 Michigan Environmental Compliance Conference

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Energy Efficiency Cost Savings

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Cost Savings Examples

- Energy Bills
- Lighting
- Variable Frequency Drives
- Air Compressors
- HVAC
- Case Studies

Energy Bills

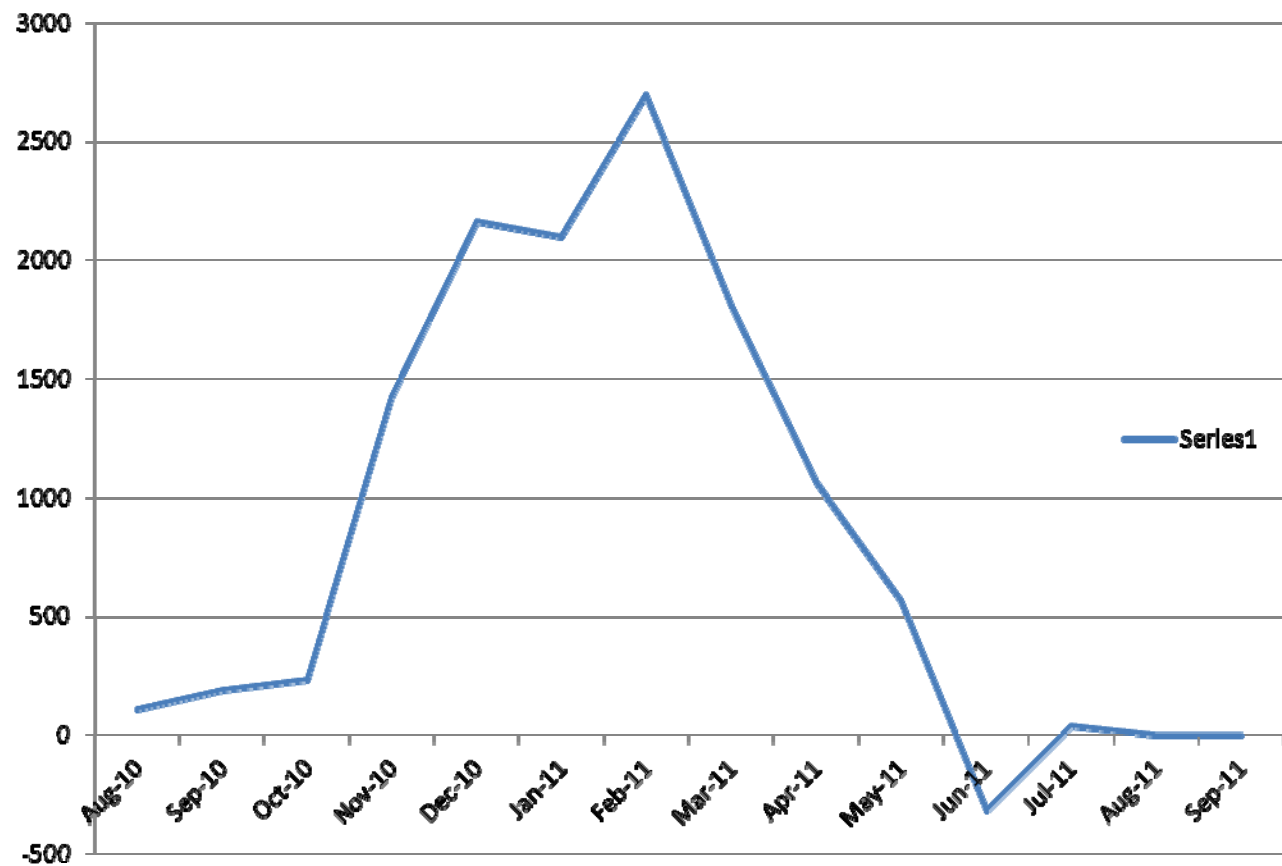
Understanding Utility Bills

- Gas bills are relatively straight forward:
 - Fixed Charge or Customer charge
 - Usage based on CCF, MCF, or Therms
 - Sales Tax
 - Commodity cost may be listed separately

Bill analysis

MONTH	DAYS BILLED	Reading Type A or E	UNITS USED Therms	Customer Chgs	Total chg	Sales Tax	Cost/Th m	Var Cost/Th m
Aug-10	30	A	109.08	\$167.23	\$320.73	\$9.16	\$2.94	\$1.41
Sep-10	32	A	187.674	\$167.23	\$384.02	\$10.97	\$2.05	\$1.16
Oct-10	29	A	230.052	\$167.23	\$407.49	\$11.64	\$1.77	\$1.04
Nov-10	31	A	1423.7	\$167.23	\$1,240.10	\$35.42	\$0.87	\$0.75
Dec-10	33	A	2164.18	\$167.99	\$1,682.14	\$48.04	\$0.78	\$0.70
Jan-11	28	A	2095.69	\$172.23	\$1,489.37	\$39.68	\$0.71	\$0.63
Feb-11	29	A	2698.09	\$172.23	\$1,732.23	\$49.47	\$0.64	\$0.58
Mar-11	31	A	1803.39	\$172.23	\$1,290.86	\$36.87	\$0.72	\$0.62
Apr-11	30	A	1062.23	\$172.23	\$900.37	\$25.71	\$0.85	\$0.69
May-11	29	E	563.805	\$172.23	\$560.92	\$16.02	\$0.99	\$0.69
Jun-11	33	E	-318.15	\$169.17	-\$45.15	-\$1.29	\$0.14	\$0.67
Jul-11	29	A	36.396	\$169.17	\$198.83	\$5.68	\$5.46	\$0.81
Aug-11	30	A	1.011	\$169.17	\$174.83	\$4.99	\$172.93	\$5.60
Sep-11	32	A	0	\$171.06	\$171.06	\$1.89	NA	NA
12 Mo Tot			11760.4	\$2,042.17	\$9,803.05	\$274.12	\$0.83	\$0.66

Bill analysis Cont'd



General Gas Cost Savings

- General Bill Savings are Limited
- Check for Proper Sales Tax Charges
- Consider third Party Provider
- Use Bill to Determine Heating Btu's

Understanding Utility Bills

- Electrical Bills are more complex
- Fixed charges including energy optimization
- Demand Charges (based on kW)
- Energy charges (based on kWh)
- Sales Tax
- Power Factor Penalty
- May have a third party provider

What is Demand?

- Cost of Electricity being available
- Calculated on Highest 15 minute usage rate (kW) during peak hours (typically 11 am to 7 pm weekdays)
- Can be as much as one-third of bill
- It's the cost paid for electricity you don't use



Bill Analysis

kW	kWh	kWh	kWh	LOAD	DEMAND	USAGE	TOTAL	SALES	UNIT	POWER	PF
BILLED	ON-PEAK	OFF-PEAK	TOTAL	FACTOR	COST	COST	COST	TAX	COST	FACTOR	PENALTY
1534	209210	537533	746743	63.38%	\$26,143.34	\$44,301.54	\$75,279.73	\$404.33	\$0.101	0.71	\$3,313.94
1613	217977	514276	732253	65.23%	\$22,731.62	\$39,730.81	\$65,445.96	\$351.51	\$0.089	0.75	\$1,515.44
1570	222938	503171	726109	62.16%	\$19,529.23	\$41,167.16	\$63,180.16	\$339.34	\$0.087	0.76	\$1,027.85
1492	208034	501942	709976	60.08%	\$18,770.40	\$38,790.64	\$59,729.74	\$320.81	\$0.084	0.77	\$731.31
1476	172009	404141	576150	49.29%	\$18,594.88	\$33,363.87	\$53,721.92	\$288.54	\$0.093	0.79	\$235.38
1512	200940	500955	701895	69.08%	\$18,989.80	\$41,954.36	\$62,474.96	\$335.55	\$0.089	0.81	
1460	200649	487641	688290	67.73%	\$18,419.36	\$41,528.86	\$61,473.65	\$330.18	\$0.089	0.81	
1345	146583	358134	504717	53.92%	\$17,157.81	\$30,416.14	\$49,032.55	\$263.35	\$0.097	0.84	
1238	112786	284709	397495	44.59%	\$15,984.02	\$24,074.96	\$41,477.00	\$222.77	\$0.104	0.88	
1273	140333	333790	474123	48.50%	\$19,983.29	\$33,325.57	\$54,846.58	\$294.58	\$0.116	0.86	
1325	137907	305104	443011	46.44%	\$20,692.65	\$31,426.07	\$53,650.01	\$288.15	\$0.121	0.85	
1408	175685	398616	574301	58.60%	\$17,050.08	\$39,431.16	\$63,780.37	\$342.57	\$0.111	0.80	
1388	186531	469047	655578	61.50%	\$21,523.26	\$45,722.39	\$69,044.58	\$370.84	\$0.105	0.79	\$272.45
1425	2122372	5061526	7183898	57.55%	\$229,426.40	\$440,931.99	\$697,857.48	\$3,748.19	\$0.097	0.81	\$3,782.43
	29.5%	70.5%			32.9%	63.2%			\$/kWh		



- **Load Factor:**
 - $\text{kWh for the period} / \text{Peak kW} \times \text{total hours in the period}$
 - Ideally 80% for three shift operation



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- **No sales tax** on manufacturing usage

General Electrical Cost Savings

- Install your own electrical meter (some utilities now offering real time meters)
- Check on Sales Taxes
- Shift usage to Off-Peak
- Reduce Demand Peaks
 - Off Peak Operation of Large Motors
 - Alternate Large Motor Operation
 - Start Heating Processes Off Peak

LIGHTING

- Most Common Area for Recommendations
- Example: Replace Metal Halide with Fluorescent Fixtures



Metal Halide:
460 watts / fixture
23,500 Mean Lumens
15 Minute Warm-up

LIGHTING (CONT'D)



Fluorescent:
T5 or T8 Fluorescent
225 Watts / Fixture
6 lamps 21,250 lumens
Instant On

LIGHTING (CONT'D)

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- Typical Payback: One to Two years
- Often Use Motion Sensors & Light Harvesting

Electrical Motors



- Three phase induction motors comprise 85% to 90% of motors in the US
- Simple in design-rugged and reliable
- Low cost
- Single phase not practical above 5-10 HP (too much current)
- Easily adaptable to VFDs

- How to determine cost of motor operation

- Horsepower
- Loading
- Operating Hours
- Efficiency

$$\text{kW} = \text{HP} \times .746\text{kW/HP} \times \text{Motor Loading} / \text{Efficiency}$$

$$\text{kWh} = \text{kW} \times \text{Annual Operating Hours}$$

Motor Cost Savings Opportunities

- Replace with Higher Efficiency Motor
 - 10 HP: Standard efficiency- 86.75%
 - Premium efficiency – 92.2%
- Savings depends on operating hours
- Payback can be two years or less

Motor Cost Savings Opportunities (cont'd)

- Install variable frequency drive
 - Now solid state devices
 - Uses existing induction motors
 - At 80% speed, uses 50% of kW
 - At 70% speed, uses 34% of kW
 - Must have a variable load
 - Often one-year payback or less

AIR COMPRESSORS

“Your Most Expensive Utility”

7 to 8 HP of Electricity to Produce 1 HP Air

Common Savings Opportunities to look for:

- Excessive Operating Pressure – 2 PSI reduction equals 1% savings
- Leakage- Typically 20% of air lost to leakage
- Piping and receiver design

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- Recover Exhaust Heat

Heating and Ventilation

- Boiler Replacements
- Control changes
- Air conditioning Replacements
- Heat Pumps



Types of Heating

- Hydronic- water/steam
- Forced Air furnaces
- Radiant
- Heat Pumps

Types of Boilers

- Fire Tube
- Water Tube
- Cast Iron
- Modular water tube
- Modular condensing water tube

Fire Tube Boiler



Modular Boilers



Boiler Cost Savings Options

- Older Boilers rated at 80% eff. Full load
- Typically run 60% eff. at part load
- Waste energy starting and stopping
- Modular Condensing boilers 98% efficient
 - Staged to run near full load
- Consider Boiler Replacement
- Recover waste heat
- Burner Replacement

Boiler Control Changes

- Variable Hydronic Heating Temperature
 - Control by Outside Air Temperature
- Variable Hydronic Heating Flow
 - VFD Pump
 - Control by Outside Air Temperature
- Variable Air Makeup
 - Use CO2 Occupancy Sensor
 - Timer
- Time of Day Thermostat or Central Control

Charlevoix County Courthouse

- May 2011 Energy Savings Project of the Year Award from Engineering Society of Detroit
- Replaced five old boilers with two 1 –Mbtu/hr Modular Condensing Boilers
- VFD's on Boiler Pumps
- Resulted in a 45% decrease in Fuel Costs
- A Reduction of 75.6 Metric Tons of CO₂

Air Conditioning / Heat Pumps

- Efficiency Ratings in SEER and EER
Seasonal Energy Efficiency Rating
Energy Efficiency Rating
- $\text{SEER/EER} = \text{BTU/Hr (cooling)}/\text{Watt}$

Typical Efficiency Ratings

Air Conditioner

- 15 to 20 year old AC: 8 to 10 SEER
- Energy Star AC: up to 21 SEER

Heat Pump

- Air Source: up to 17 SEER
- Water Source: up to 28 SEER??

Air Conditioning Cost Savings Options

- Replace Units with Higher SEER Rated
- Ensure Regular Cleaning and Maintenance
- Use Setback Thermostats



Case Studies

Seimans Industries, Benton Harbor, MI
Flexfab, LLC, Hastings, MI



Energy Assessments Success Stories

- RETAP Helps Siemens Save Over \$125,000 Annually
- Siemens Industry Inc., Benton Harbor
- RETAP completed the on-site pollution prevention assessment in August, 2008
- Made 35 recommendations, total \$29,000



Siemens VAI Services, LLC, Benton Harbor, Michigan

Recommendation Description	Estimated Annual Savings		Estimated Cost	Payback Time	
	Resource	Value			
Establish an environmental affairs team involving management and other employees and set added specific, measurable goals.	All forms of waste and energy use	\$5,500 for 2% added goal			
Collect and recycle spent fluorescent, metal halide, and high pressure sodium lamps because they contain mercury.	11,000 mg Hg & 450 lbs. of recyclable waste	P2	\$0	Immediate for P2	
Investigate using aqueous based cleaners to replace the naphtha based cleaners.	Hazardous liquid	P2, Cost control			
Disconnect the lights and ballasts from five vending machines.	4,200 kWh	\$205	\$0	Immediate	
Conduct a light meter audit throughout the facility.	Electricity for lighting	E2, Cost control	Low		



RETIRED ENGINEER
TECHNICAL ASSISTANCE PROGRAM

LT-2	Replace the metal halide fixtures with 4-ft., 6-lamp T8 fluorescent fixtures and metalized reflectors.	131,600 kWh	\$6,500	\$21,300	3.3 years
LT-3	Retrofit T12 fluorescent lighting in the main office and plant areas with 35 percent more efficient T8 fluorescent lamps and electronic ballasts, and reduce the 4-lamp fixtures to two lamps each.	17,300 kWh for 4-lamp fixtures 51,200 kWh for all	\$850 for 4-lamp \$2,500 for all	\$2,470 \$10,900	2.9 years 4.4 years
LT-4	Replace 56 8-ft., 2-lamp T12 fluorescent fixture security lights with 8-ft., 2-lamp T8 fluorescent fixtures with electronic ballasts.	16,500 kWh	\$800	\$3,360	4.2 years
LT-5	Install occupancy detectors to control the lighting in areas not continuously in use.	350 kWh per detector	\$17	\$40	2.3 years
NG-1 HC-3 HC-4	Examine opportunities to capture heat (especially in winter months) from the high volume of air that is currently exhausted from the building.	Natural Gas	E2, Cost control		

HC-2	Install recirculation fans in the high ceiling areas of the main plant.	Natural Gas Electricity	\$9,700		
CA-1	Institute leak detection and repair program for the compressed air system.	38,600 kWh	\$1,890	Low	Virtually Immediate
CA-3	Reduce the compressed air system operating pressure to the minimum required by equipment.	19,200 kWh for 10 psi reduction	\$945	\$0	Immediate
CA-4	Lower the compressor intake air temperature by supplying outside air.	11,600 kWh	\$570	\$0	Immediate



Flexfab, LLC, Hastings, MI

- Manufacturers silicone rubber and other elastomers
- RETAP Assessment Oct 2008, with 60 recommendations, \$250,000 total savings
- Implemented 49 recommendations
- Annual savings of \$162,000

Flexfab (contd)

- Improved recycling program that reduced the number of containers going to landfill and saved \$4,500 in disposal costs.
- Replaced 400-watt metal halides and T12 fluorescent lamps with T8 fluorescents and reduced number of lamps in fixtures saving 308,000 kWh and \$24,000 per year. Received rebates from Consumers Energy totaling \$21,000.
- Upgraded/installed more efficient gas fired ovens saving 8,100 mcf and \$79,500.
- Equalized natural gas delivery cost between plants saving about \$2,500.
- Reduced sewer charges for boiler water and process water not going to the sewer, saving \$25,000 per year.
- Reduced operating pressure of air compressors saving 32,000 kWh and \$2,600.
- Instituted a regular compressed air leak detection saving 36000 kWh and \$3000 per year



Energy Assessment Programs

Programs / Organizations providing free or low cost energy efficiency assistance to small businesses:

Better Buildings (Detroit Commercial) – no cost – (313) 237-4601

Clean Energy Coalition – fee based – (734) 585-5720 ext.11

Delta Institute – fee based – (517) 482-8810

Green Lodging Michigan – no cost – (517) 241-6224

Industrial Assessment Center – no cost – (734) 647-4790

Michigan Energy Options – fee based – (517) 337-0422

Michigan Farm Energy Audit Program – \$500 – (517) 353-0643

Michigan Industrial Energy Center – no cost – (734) 763-7470

Michigan Manufacturing Technology Center – fee based – (888) 414-6682

Rebuild Michigan – no cost – (517) 241-6281

WARM Training Center – fee based – (313) 894-1030

- Onsite Pollution Prevention & Energy Conservation Assessments Conducted by Teams of Retired Engineers
- Free
- Confidential
- Non-Regulatory
- No Obligations
- Objective

www.michigan.gov/retap





How can companies contact RETAP or get more Info?



David Herb

800-662-9278

517-241-8176 (direct)

herbd@michigan.gov

**Retired Engineer
Technical Assistance
Foundation**

888-749-7886

248-478-8192 (fax)

www.michigan.gov/retap